capable of moving the tape from the supply reel to the take-up reel past said head;

whereas the length of the head assembly surface that is in contact with the tape surface is substantially less than the width of the tape.

13. (Currently Amended) A tape recording device ~~drive~~ according to claim 12 whereas the length of the head assembly surface that is in contact with the tape surface is less than 50% of the width of the tape.

14. (Currently Amended) A tape recording device ~~drive~~ according to claim 12 whereas the length of the head assembly surface that is in contact with the tape surface substantially matches the width of a track group

Remarks

Pursuant to 37 CFR 1.121(f), no new matter has been added. As set forth below, moving the head towards the tape, reducing the mass of the head, and reducing the head assembly surface to tape surface area are described in Applicant's original disclosure.

Claim Rejections – 35 USC § 112

Prior art recorders address the problem of tape to head separation by means that move the tape towards a head while the head is stationary in a direction normal to the tape. The present application takes a fundamentally different approach: The tape is held stationary, but the head is moved towards the tape.

Prior art is silent about the importance of limited tape to head contact surface. The present application discloses a design that limits the tape to head contact surface.

Claims 1-7 and 12-14, as amended, particularly point out and distinctly claim the subject matter which the applicant regards as his invention.

Claim 2 is amended to overcome the objections of the Examiner. The wording "recording system" is amended to "tape recording device".

The wording "further comprising a spring" is amended to "additionally comprising a spring".

Claim 2 is further amended to clarify that the spring enhances the bias of the flexure.

Claims 13 and 14 are amended to overcome the objections of the Examiner. The wording "tape drive" is amended to "tape recording device".

Claims 4- 7 are amended to overcome the objections of the Examiner. The word "stabilizer" is replaced by "means to stabilize the tape".

Claim Rejections – 35 USC § 102

Claims 1-2:

The present application shows a structure that allows movement of the head *towards* the tape and additionally biases the head towards the tape. In US Patent 5,166,848 Plachy shows a head-mounting structure that is substantially different both in its design and in its purpose from the invention of the present application.

The structure disclosed by Plachy does not move the head towards the tape nor is it capable of doing so. Although Plachy's structure does include a flexure 13 (shown in Fig 2), the flexure is a component of the head actuator. The purpose of Plachy's flexure is to allow movement of the head in *lateral* direction across the recording surface of the tape in order to follow the movements of the recorded tracks. Plachy clearly explains the purpose as that of "simplify[ing] the structure associated with supporting the head for tracking the individual tracks disposed on tape ..." (1, 27-29).

The Examiner notes that Plachy shows a recording system that is "capable of moving said head 20 **across** the recording surface of said tape" (page 5, lines 4 - 5; emphasis by applicant). However, Applicant notes that the word "across" fails to include an ability of movement of the head *towards* the tape.

In Figure 2, Plachy shows that Flexure 13 is bendable along its length and thus does not allow the head to move towards the recording surface of the tape, nor does it allow the head to move so that the head surface is in alignment with the tape surface. Plachy agrees: "Mounted on support 12 is an elongated beam flexure member of a plate 13 having a thickness substantially less than its length or its width, thus rendering flex plate 13 readily bendable along its length."(3, 55-59).

The present application shows a structure that allows movement of the head towards the tape in order to limit the distance between the tape and the head. Plachy describes his structure that defines the distance between the head and the tape in the specification as "stationary" (3, 46) and as "substantially rigid" (4, 22), meaning not movable.

Applicant notes that controlling the separation between the tape and the head is generally not a concern in helical recording devices.

Therefore, the flexure of the present application is different in its purpose and in its design from the flexure disclosed by Plachy. A purpose of the flexure as disclosed and claimed in the current application is to minimize the separation between the head and the tape, a recognized problem of linear recording devices.

The flexure of the current application has two aspects, which are described in the specification and claimed in the Claims:

1. It allows the head to move towards the recording surface of the tape and it biases the head towards the tape.
2. It allows the head to move within the plane of the tape surface so that head surface is substantially aligned with the tape surface.

Claim 1 is amended to point out the ability of the head to move *towards* the tape.

Claim 1 is further amended to clarify that the alignment of the head *surface* is with the tape *surface*.

Modified Claim 1 is consistent with the specification.

Claims 3-7:

Plachy does not show any means to stabilize tape nor does he intend to do so.

Plachy presents a helical recording device. (The present application applies to *linear* recording devices, as explained in its specification). Helical recording devices record data tracks *diagonally* across the surface of the tape. A drum is mounted rotatably at an angle to the longitudinal tape direction. The recording heads are mounted on the surface of the rotating drum and are traversing the recording surface of the longitudinally moving tape in a diagonal fashion. In Plachy's words, "A window opening (not shown) in the rotatable drum surface projects a diagonal trace on a tape helically wrapped across surface 6." (3, 44-46).

An external means, such as an electrical motor, must rotate the drum. Even minute manufacturing defects of the motor and other components of the drum assembly can cause vibrations that destabilize the tape. Considering that the drum surface must move substantially faster than the tape, a further factor causing possible tape disturbances is the close proximity of the drum surface to the tape surface while traveling at substantially different speed than the tape surface. Drum assemblies of helical recorders are not means to stabilize tape but are a known source of disturbances. As a result, they are only employed when dictated by the recording technology, as is the case in helical tape drives.

The stabilization technologies of claims 3-7 are unique and substantially different from the drum assembly shown in US Patent 5,166,848.

Claims 12:

The specification of the present application shows that the size of the head assembly does matter in linear recording devices. Friction generated by moving the tape surface across a stationary head is the foremost cause of wear on the tape surface. Wear results in damage that increases significantly with the number of times the tape passes across the head. In addition, wear produces debris, which compounds the damage and causes recording errors. The head assembly surface in prior designs contacts the entire width of the tape, even though the head may record data on only a small area. Thus, a major objective of the present invention is to limit tape wear and damage by reducing the area of tape that the recording head touches. As an example, see Fig 4 of the present application.

US Patent 6,369,982 by Saliba presents a read-only head somewhat smaller than the width of the tape, describing it as follows: "The preferred longitudinal dimension (h1) of the head body (302) along the mesa 304 is 0.407 inch, which is less than the nominal width (tw, e.g. 0.5 inch) of the tape 10" (9,66–10,1). A reduction of less than 20% is far below the optimal amount shown in the current application. In addition, Saliba fails to recognize the importance of limiting the size of surface contact between the head and the tape, remaining silent about this important issue.

The design of the current application limits contact between the head and the tape by reducing the head to the minimum size that will work in reading and recording data. This is a unique and distinct improvement over the prior art.

Claim Rejections – 35 USC § 103

The head of the current application contacts substantially less than half the width of the tape with each pass. This limited contact results in substantially less than half the wear on the tape as that of former technologies. The present application further shows how to shrink contact of the head to as little as one track group on the surface width of the tape. The unique features of both reduced head size and limited contact with the tape surface fundamentally differentiate the current data storage and retrieval process from the state of prior art.

It is well known that the implementation of a head that is smaller than the width of the tape is very problematic in prior art recorders. As a result, there are no prior art recorders with a head to tape contact area that is substantially smaller than the width of the tape. Applicant's disclosure shows a unique design that avoids the problems of prior art. For illustration, one of these problems is now described.

Tape is very flexible. When tape is moved across a head that is smaller than the width of the tape, the unsupported edges of the tape will curl around the head. This will inevitably result in tape damage.

Biskeborn in US Patent 5,883,770 shows an element housing (which Biskeborn terms the "head,") that is smaller than the width of the tape. To overcome the above described problem of edge curling, Biskeborn adds outriggers (70) that contact the entire width of the tape. Biskeborn describes his design: "The outriggers 70 extend the full width of the tape 72, while head 71 moves in lateral direction between tracks" (6, 6–8). The addition of the outriggers to the head assembly defeat the purpose of the small element housing and Biskeborn does not achieves the advantage of reduced head assembly to tape contact that is disclosed in the present application.

In US Patent 6,369,982 Saliba presents a head that is somewhat smaller than the width of the tape. However, the small head is used together with, and adjacent to, a head that is wider than the width of the tape. This second, wider head is in this context the equivalent of Biskeborn's outriggers.

Prior art recorders are not able to overcome the problems associated with reduced head surface to tape surface contact.

In contrast to prior art, the current application takes a fundamentally different approach. The tape is head stationary by means that stabilize the tape. The head is moved towards the stabilized tape and the above problem is avoided.

Applicant showed above the importance of limiting the size of surface contact between the head assembly and the tape in order to minimize wear. Applicant showed that the size of the head can be less than 50% of the tape width and that it can be as small as one track group.

Applicant further showed means to implement the reduced size head by disclosing means to stabilize the tape and by moving the head towards the stabilized tape.

This solution to a well-known problem is a significant improvement over prior art. Applicant's solution is unique and not obvious to those skilled in the art.

Conclusion

Tape recorders of prior art commonly feature well-known bearings such as rollers, hydrodynamic bearings, hydrostatic bearings, and the like. These bearings serve dual purposes:

1. They define the path of the tape on its way from supply reel, through recording elements, to take-up reel. The definition of the tape path may include determination of the wrap angle of the tape over a stationary head, as shown by Zwettler in US Patent 6,249,401.
2. They limit the lateral movement of the tape, a process called "tape guiding." The bearing shown by Winarski in US Patent 6,822,820 is an example of a bearing that performs both functions.

The stabilization technologies of Claims 3–7 are substantially different from the prior art.

Prior designs attempt to prevent separation of the tape from the read-write head by increasing tape tension and wrap angle, decreasing tape speed, placing air-bleeding slots in the head, and other methods. All of them move the tape towards the head assembly while the head remains stationary. In contrast, the current application moves the head towards the tape while the tape remains stationary, and Claims 3–7 describe means to prevent movement of the tape, while the head is moved. Prior art does not address holding the tape stationary because its designs do not require that feature. Thus, the current application employs a fundamentally different solution to a well known problem.

As described above, the head assembly shown by Biskeborn includes outriggers (70) which contact the entire width of the tape (72). (Figure 12 illustrates the arrangement) By contrast, the contact area of the head assembly in the current application is substantially narrower than the width of the tape surface.

Claims 12–14 have been amended for clarification.

Applicant respectfully requests the Examiner to pass this application to allowance.

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